

The Operative Treatment of Closed Tibial Fractures

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ABSTRACT

The tibia is a subcutaneous bone. Operative fixation of tibial fractures is a demanding undertaking. Thirty-five patients with 36 tibial fractures were admitted to our institution between May 1995 and April 1996. The patients were predominantly male (male to female ratio of 4) and the average age of the patients was 31.4 years (range 14 to 67 years).

Ten fractures were located in the proximal third, 18 in the middle third and 8 in the distal third. The indications for operation included displaced intra-articular fragments, failed conservative treatment, compartment syndrome, multiple fractures and unstable fracture configuration.

Operative procedures included plating in 29 cases and nailing in 7 cases. These patients were reviewed retrospectively and assessed for complications and radiological and functional outcome. The overall results were satisfactory in 88.9% and poor in 11.1%.

The complications were reviewed and various factors affecting the incidences analysed. Three deep infections occurred. All were found after discharge from inpatient care. A prolonged interval between admission and surgery as well as high energy of impact are thought to be the main contributing factors.

Keywords: closed tibial fractures, operative treatment

INTRODUCTION

The tibia is a unique bone in that it is subcutaneous throughout most of its length. Closed tibial fractures are treated non-operatively in the vast majority of cases⁽¹⁾. Such fractures requiring surgical treatment are relatively uncommon. It would take a typical surgeon in training a number of years to amass the necessary information to comfortably handle fractures of this nature. The authors felt that this would be an interesting subset of cases to study to that end.

MATERIALS AND METHODS

This is a retrospective study. Case records, ambulance records, X-rays and workmen compensation awards were reviewed from the period between 1 May 1995 and 31 April 1996. In addition, telephone interviews regarding work and functional status were conducted. 28 patients (80%) were interviewed in this way.

One hundred and twenty-one cases of tibial fractures were admitted to our centre during the period under study. Tibial fractures were defined as diaphyseal fractures excluding the proximal and distal 5 cm of this bone⁽²⁾. Thirty-five of these patients had closed injuries requiring surgery. One patient had bilateral tibial fractures. Thirty-six fractures were therefore studied. The rest had open injuries or were successfully treated non-operatively and were excluded.

The average age in the group was 31.4 years (range 14 to 67 years). There were 31 males to 4 females. The racial distribution was 57% Chinese, 25.7% Malay, 14.3% Indian and 2.9% other races. Mean follow up was 18.9 months (range 14 to 25 months).

Distribution by occupation showed that construction workers were over-represented (Table I). This did not correlate with the mechanism of injury which was mainly motorcycle accidents (Table II).

Table I – Distribution by occupation

Category	Description	Patients
Sedentary	Student	6
	Engineer	1
	Financial manager	1
Light manual	Salesman	2
	Hospital assistant	1
	Factory	5
	Bus driver	2
	Fireman	1
Heavy manual	Military personnel	4
	Construction worker	12
	Fireman	1

Table II – Distribution by mechanism

Category	Description	Patients
Road traffic accident	Motorcycle	17
	Pedestrian	5
	Car	1
	Cyclist	1
Industrial accident	Fall from height	1
	Hit by metal bar	3
Sports	Soccer	4
	Rugby	1
	Skateboard	1
Others	Assault	1

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RESULTS

The indication for surgery most commonly quoted is unacceptable reduction by conservative means⁽³⁾. This encompasses a reduction to within 5 degrees of varus or valgus, 5 to 10 degrees anterior or posterior angulation, 1.0 to 1.5 cm shortening and less than 50 percent translation⁽⁴⁾. Twenty of the cases reviewed were operated on early due to unstable fracture configuration in the form of comminution, initial translation of more than 50 percent and obliquity. In addition, 10 cases had concomitant intra-articular fractures that warranted surgery from the outset. One had compartment syndrome that was decompressed and stabilised at the same sitting. Two fractures occurred in multiply injured patients in whom operative stabilisation was opted for to facilitate early mobilisation. Only 3 cases were operated on due to a failed trial of conservative measures.

The assessment criteria used was based on the audit of SA Bridgman and K Baird⁽⁵⁾. This reviewed functional outcome measures at 1 year, radiological findings and complication rates.

Functional outcome was based on the measures devised by Johner R and Wruhs⁽⁶⁾. This is classified as excellent if there is normal function, good if there is mild pain, fair if there is moderate pain and poor if there is severe pain or abnormal gait. By this criteria 11.1% had a poor outcome, none were fair, 8.3% were good and 80.6% were excellent at 1 year. In the context of this paper complications refer to pathological processes like infection while results refer to functional outcome.

The overall complication rate was 27.7% (Table III). The orthopaedic complication rate was 19.4%. The average hospital stay was 9.3 days. The majority were discharged within 8 days. Delays in hospitalisation were only rarely due to orthopaedic complications per se (Table IV).

Table III – Complications encountered

Category	Description	Fractures
General		3 (8.3%)
	Anaemia	2
	Urinary tract infection	1
Orthopaedic		7 (19.4%)
	Deep infection	3
	Non-union	2
	Malunion	1
	Volkman ischaemia	1

Table IV – Distribution by hospital stay

Duration	Patients	Reason for delay
< 8 days	19	
8 to 14 days	10	1 anaemia 1 superficial infection
> 14 days	6	1 anaemia 1 fasciotomy & skin graft 1 skull & rib fractures 1 pneumothorax 2 social reasons

Furthermore, it was found that most complications occurred with a greater interval between admission and surgery (Table V).

Poor results were also more common in high energy injuries, namely, road traffic accidents (Table VI). This finding is in line with the finding by Sarmiento A and Sharpes F where of the 943 tibial shaft fractures reviewed, prolonged healing occurred in high energy injuries⁽¹⁾.

In terms of anatomical site, fractures in the middle third tended to have poorer results (Table VII).

Current recommendations^(4,7) for closed tibial fractures include the use of unreamed intramedullary nails in cases with severe soft tissue injury and reamed nails in cases with minimal swelling. The use of plates allow for anatomic reduction with arguably less specialised expertise. They are, however associated with an increased incidence of soft tissue infection and do not allow for early weight bearing. All these methods were used in this study. It was found that the use of plates were associated with a higher rate of complications (Table VIII).

The number of surgeons as well as their seniority was well distributed among cases. There was no apparent difference in outcome as a result of seniority or number (Table IX). This was probably because the theoretical advantage of having more than 1 surgeon was offset by the fact that more than one surgeon would be required in more serious cases especially in the presence of junior staff.

The deep infections were studied in greater detail. There were three cases in all. Two had methicillin-resistant *staphylococcus aureus* (MRSA) infections and one contracted a pseudomonal infection. All cases were treated by different surgeons. The pseudomonas infection was sustained by a pedestrian while the two MRSA infections were sustained in motorcycle accidents. All developed the infections despite being adequately covered perioperatively with a first generation cephalosporin. They were discovered only after discharge from inpatient care.

The first case, MLHM, a 36-year-old Malay male was involved in a motorcycle accident. He was operated on 3 days later. His infection was found after discharge. His implant, a plate, was removed after 10 months and he subsequently had an excellent outcome.

The next case, FSC, a 49-year-old Chinese male was the pedestrian. He had a small wound in close proximity to the fracture. This was allowed to heal. He was subsequently operated on 18 days later. The infection was found after discharge. The plate was removed and the wound debrided. He was well 6 months later with an excellent outcome.

The third case, AMMA a 39-year-old Malay male was involved in a motorcycle accident. Surgery was performed after 5 days. One month later he was readmitted for an infection. He subsequently had two operations and an external fixator applied. After 1 year this was removed and bone grafting

Table V – Interval between admission and surgery

Interval	Patients	Complications	Reasons for delay
D0	14	1 anaemia 1 Volkmann ischaemia	
D1 – D3	13	1 deep infection 1 urinary tract infection 1 anaemia 1 non-union	
> D3	8	2 deep infection 1 non-union 1 anaemia	3 failed manipulation 2 medical referral 1 pneumothorax 1 abrasion

Table VI – Mechanism of injury correlated with results

Mechanism	Patients	Results	Numbers
Motorcycle	17	Excellent Poor	14 3
Pedestrian	5	Excellent Poor	4 1
Sport	6	Excellent Good	5 1
Industrial	4	Excellent Good	2 2
Others	3	Excellent	3

Table VII – Anatomical sites with respect to results and complications

Position	Fractures	Results	Complications
Proximal third	10		2 deep infection
Middle third	18	3 poor	1 deep infection
Distal third	8	1 poor	

Table VIII – Operations correlated with complications

Modality	Fractures	Results	Complications
Dynamic compression plate	19	3 poor	1 deep infection
Buttress plate	10		2 deep infection
Reamed nail	5	1 poor	
Unreamed nail	2		

Table IX – Number of surgeons correlated with results

Number	Fractures	Complications
2	12 excellent 2 good 4 poor	1 Volkman ischaemia 2 deep infection
1	17 excellent 1 good	1 deep infection

and plating was done for non-union. His fracture has still failed to unite and his outcome remains poor.

The only other case of non-union was that of a 26-year-old Chinese male who sustained a midshaft fracture for whom an intramedullary nail was used. His fibula was intact. This required a fibular osteotomy and grafting to treat the non-union. He subsequently had an excellent result.

DISCUSSION

A literature review reveals that few papers have been written specifically about the surgical management of closed tibial fractures. Most papers boast a modest population of between 16 to 47 patients⁽¹⁰⁾. This underscores the great number of these fractures that are treated conservatively. More recently however, work comparing conservative and surgical options as well as nailing methods has been done with larger populations^(3,7).

In a study on 40 patients treated by plating, Fisher et al⁽⁹⁾ had a deep infection rate and delayed union rate of 15% compared with 10% and 3.3% respectively here. While the infection rate was comparable we differed in our definition of delayed union as 6 months and non-union as 1 year after injury after Bridgman et al⁽⁵⁾. Their definition of 20 months should however result in a lower non-union rate and it is unclear why this is not the case.

The rates of non-union and infection are, as discussed above, lower with intramedullary fixation⁽¹⁰⁾. Gregory P et al in their use of intramedullary nails in 47 cases report a deep infection rate of 2.6% and a non-union rate of 8%. This supports the use of such devices in the treatment of such fractures.

Complications tended to occur more commonly in our series in the presence of high impact injuries and delays before surgery. High impact injuries cause tissue devitalisation and hence a predisposition to infection. Delays before surgery defer rehabilitation and hence general wellbeing. Skin colonisation with nosocomial pathogens is another possible predisposition to infection. This supports a policy of rapid optimization and surgery without delay as indicated.

CONCLUSION

The greatest difficulty faced in this study was the determination of set standards by which to assess results. By comparing results with the more complementary of available literature it is hoped that this study would provide valuable information in the treatment of closed tibial fractures. The results suggest that a policy of early treatment, the degree of damage notwithstanding, with intramedullary nails is the treatment of choice. Plates, though expedient, should be avoided in isolated tibial fractures. Infections warrant early and aggressive treatment to avoid long-term sequelae.

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